AMENDMENTS TO THE CLAIMS

The claims in this listing will replace all prior versions, and listings, of claims in the application.

1. (Original) An optical element retracting mechanism for a retractable lens including an optical system having a plurality of optical elements, said optical element retracting mechanism comprising:

a linearly movable ring configured to be guided along an optical axis of said optical system without rotating, and retracting toward a picture plane along said optical axis when said retractable lens moves from an operational state to a fully-retracted state;

a swingable holder pivoted on a pivot and swingable about said pivot, and positioned inside and supporting said linearly movable ring, said swingable holder supporting a retractable optical element as one of said plurality of optical elements;

a holding device holding said swingable holder such that said retractable optical element remains on said optical axis when said retractable lens is in said operational state; and

a retracting device configured to rotate said swingable holder about said pivot such that said retractable optical element retracts to a position which deviates from said optical axis, when said linearly movable ring, together with said swingable holder, retracts toward said picture plane,

wherein said holding device comprises:

an adjusting shaft having a shaft axis generally parallel to said optical axis, supported by said linearly movable ring and rotatable about said shaft axis, and including an eccentric pin having an axis eccentric to said shaft axis of said adjusting shaft, wherein

said eccentric pin is engaged with said swingable holder to set a limit for rotational movement of said swingable holder when said swingable holder is in a photographing position in which said retractable lens is in said operational state; and

a spring configured to bias said swingable holder to rotate said swingable holder in an advancing direction to engage said swingable holder with said eccentric pin; and

wherein a position of said retractable optical element is configured to be varied in said operational state, in a plane generally orthogonal to said optical axis by a rotation of said adjusting shaft.

2. (Original) The optical element retracting mechanism according to claim 1, wherein said linearly movable ring comprises a through hole which penetrates through said linearly movable ring in said optical axis direction, and in which said adjusting shaft is supported by said linearly movable ring and rotatable about said axis of said adjusting shaft, said eccentric pin projecting from said through hole.

3. (Original) The optical element retracting mechanism according to claim 1, further comprising:

a pair of support plates which are attached to front and rear surfaces of said linearly movable ring in said optical axis direction to support opposite ends of said pivot, respectively, wherein a pair of first elongated holes and a pair of second elongated holes are located on said pair of support plates, respectively, such that said pair of first elongated holes face each other in said optical axis direction and extend generally parallel to each other and such that said pair of second elongated holes face each other in said optical axis direction and extend generally parallel to each other, a direction of elongation of said pair of first elongated holes generally orthogonal to a direction of elongation of

said pair of second elongated holes;

a support plate fixing device for fixing said pair of support plates to said linearly movable ring, wherein said support plate fixing device allows said pair of support plates to move relative to said linearly movable ring in directions lying in a plane generally orthogonal to said optical axis when said support plate fixing device is in a released state;

a first rotatable shaft having a first axis generally parallel to said optical axis, supported by said linearly movable ring to be rotatable about said first axis, and having a pair of first eccentric pins at opposite ends of said first rotatable shaft, each of said pair of first eccentric pins having an axis eccentric to said first axis, said pair of first eccentric pins respectively engaged in said pair of first elongated holes to be movable therein in said direction of elongation of said first elongated hole, wherein when said first rotatable shaft is rotated, a first movement force is applied on said pair of support plates in a direction generally orthogonal to said direction of elongation of said first elongated hole;

a second rotatable shaft having a second axis generally parallel to said optical axis, supported by said linearly movable ring to be rotatable about said second axis, and having a pair of second eccentric pins at opposite ends of said second rotatable shaft, each of said pair of second eccentric pins having an axis eccentric to said second axis, said pair of second eccentric pins respectively engaged in said pair of second elongated holes to be movable therein in said direction of elongation of said second elongated hole, wherein when said second rotatable shaft is rotated, a second movement force is applied on said pair of support plates in a direction generally orthogonal to said direction of elongation of said second elongated hole; and

a movement direction setting device, provided on said pair of support plates and

said linearly movable ring, configured to set the direction of movement of said pair of support plates in a plane generally orthogonal to said optical axis when at least one of said first and second movement force is respectively applied on said pair of support plates by at least one of said rotation of said first rotatable shaft and said rotation of said second rotatable shaft when said support plate fixing device is in said released state.

4. (Original) The optical element retracting mechanism according to claim 3, wherein said movement direction setting device comprises:

a pair of third elongated holes located on said pair of support plates, respectively, to face each other in said optical axis direction and extend generally parallel to each other so that a direction of elongation of said pair of third elongated holes is generally parallel to one of said direction of elongation of said pair of first elongated holes and said direction of elongation of said pair of second elongated holes; and

a pair of front and rear projections which project from front and rear of said linearly movable ring to be engaged in said pair of third elongated holes to be movable therein, respectively,

wherein a rotation of one of said first rotatable shaft and said second rotatable shaft causes said pair of support plates to move linearly along a direction of elongation of one of said pair of first elongated holes and said pair of second elongated holes with which the other of said first rotatable shaft and said second rotatable shaft is engaged, and

wherein a rotation of said other of said first rotatable shaft and said second rotatable shaft causes said pair of support plates to move non-linearly along a direction substantially orthogonal to said direction of elongation of said one of said pair of first elongated holes and said pair of second elongated holes.

5. (Original) The optical element retracting mechanism according to claim 3, wherein said movement direction setting device comprises:

a pair of third elongated holes located on said pair of support plates, respectively, that face each other in said optical axis direction and extend generally parallel to each other such that a direction of elongation of said pair of third elongated holes is inclined to both said direction of elongation of said pair of first elongated holes and said direction of elongation of said pair of second elongated holes; and

a pair of front and rear projections projecting from front and rear of said linearly movable ring and engage said pair of third elongated holes and are movable therein, respectively,

wherein a rotation of one of said first rotatable shaft and said second rotatable shaft causes said pair of support plates to move non-linearly along a direction including a component of said direction of elongation of said pair of second elongated holes, in which said pair of second eccentric pins of said second rotatable shaft are engaged, respectively, and

wherein a rotation of the other of said first rotatable shaft and said second rotatable shaft causes said pair of support plates to move non-linearly along a direction including a component of said direction of elongation of said pair of first elongated holes, in which said pair of first eccentric pins of said first rotatable shaft are engaged, respectively.

6. (Original) The optical element retracting mechanism according to claim 1, wherein said plurality of optical elements comprise at least one rear optical element positioned behind said retractable optical element when said retractable lens is in said

operational state; and

wherein said retractable optical element is positioned in an off-axis space radially outside an on-axis space in which said rear optical element is positioned, such that said retractable optical element and said rear optical element are in substantially a same positional range in the optical axis direction, when said retractable lens is in said fully-retracted state.

7. (Original) The optical element retracting mechanism according to claim 1, wherein said swingable holder further comprises:

a cylindrical lens holder portion holding said retractable optical element;

a pivoted cylindrical portion rotatably fitted about said pivot;

a swing arm portion located between said cylindrical lens holder and said pivoted cylindrical portion, said swing arm portion connecting said cylindrical lens holder to said pivoted cylindrical portion; and

an engaging protrusion extending from said cylindrical lens holder portion, said engaging protrusion engaged by said eccentric pin of said adjusting shaft, when said swingable holder is in an operational position.

8. (Original) The optical element retracting mechanism according to claim 1, wherein said retractable optical element comprises a lens group.

9. (Original) The optical element retracting mechanism according to claim 1, wherein said optical system comprises a zoom photographing optical system; and

wherein said retractable optical element comprises a lens group as a part of said zoom photographing optical system.

10. (Original) The optical element retracting mechanism according to claim 1,

wherein said optical element retracting mechanism is incorporated in a digital camera.

11. (Original) The optical element retracting mechanism according to claim 1, wherein said adjusting shaft comprises an operating portion via which said rotatable pin of said adjusting shaft can be rotated, and

wherein said operating portion is exposed to one of a front side and a rear side of said linearly movable ring and is accessible from one of said front side and said rear side of said linearly movable ring, respectively.

12. (Original) The optical element retracting mechanism according to claim 9, wherein said operating portion of said adjusting shaft faces a frontward direction in the optical axis direction,

wherein said optical element retracting mechanism further comprises:

an outer barrel which surrounds said linearly movable ring, and has a radially inward flange located in front of said linearly movable ring,

wherein said radially inward flange includes a front through hole which penetrates through said radially inward flange in said optical axis direction, said operating portion of said adjusting shaft accessible from the front side of said linearly movable ring through said front through hole of said radially inward flange.

13. (Original) The optical element retracting mechanism according to claim 12, wherein said retractable lens comprises a lens barrier mechanism detachably attached to a front part of said radially inward flange to cover said front through hole of said radially inward flange.

14. (Original) The optical element retracting mechanism according to claim 12, wherein said outer barrel supports one of said plurality of optical elements which is

positioned in front of said retractable optical element, said outer barrel retracting toward said picture plane together with said linearly movable ring along said optical axis when said retractable lens moves from said operational state to said fully-retracted state.

15. (Original) The optical element retracting mechanism according to claim 11, wherein said operating portion of said adjusting shaft comprises a slot in which an adjusting tool can be engaged.

16. (New) A digital camera having a body and a lens barrel, the lens barrel housed within the body, the lens barrel comprising a retractable lens including an optical system having a plurality of optical elements, the lens barrel further comprising a retracting mechanism, the retracting mechanism comprising:

a linearly movable ring configured to be guided along an optical axis of said optical system, and retracting toward a picture plane along said optical axis when said retractable lens moves from an operational state to a fully-retracted state;

a swingable holder pivoted on a pivot and swingable about said pivot, and positioned substantially inside and supporting said linearly movable ring, said swingable holder supporting a retractable optical element as one of said plurality of optical elements;

a holding device holding said swingable holder such that said retractable optical element remains on said optical axis when said retractable lens is in said operational state; and

a retracting device configured to rotate said swingable holder about said pivot such that said retractable optical element retracts to a position which deviates from said optical axis, when said linearly movable ring, together with said swingable holder,

retracts toward said picture plane,

wherein said holding device comprises:

an adjusting shaft having a shaft axis generally parallel to said optical axis, supported by said linearly movable ring and rotatable about said shaft axis, and including an eccentric pin having an axis eccentric to said shaft axis of said adjusting shaft, wherein said eccentric pin is engaged with said swingable holder to set a limit for rotational movement of said swingable holder when said swingable holder is in a photographing position in which said retractable lens is in said operational state; and

a spring configured to bias said swingable holder to rotate said swingable holder in an advancing direction to engage said swingable holder with said eccentric pin; and

wherein a position of said retractable optical element is configured to be varied in said operational state, in a plane generally orthogonal to said optical axis by a rotation of said adjusting shaft.

17. (New) The camera according to claim 16, wherein said linearly movable ring comprises a through hole which penetrates through said linearly movable ring in said optical axis direction, and in which said adjusting shaft is supported by said linearly movable ring and rotatable about said axis of said adjusting shaft, said eccentric pin projecting from said through hole.

18. (New) The camera according to claim 16, further comprising:

a pair of support plates which are attached to front and rear surfaces of said linearly movable ring in said optical axis direction to support opposite ends of said pivot, respectively, wherein a pair of first elongated holes and a pair of second elongated holes are located on said pair of support plates, respectively, such that said pair of first

elongated holes face each other in said optical axis direction and extend generally parallel to each other and such that said pair of second elongated holes face each other in said optical axis direction and extend generally parallel to each other, a direction of elongation of said pair of first elongated holes generally orthogonal to a direction of elongation of said pair of second elongated holes;

a support plate fixing device for fixing said pair of support plates to said linearly movable ring, wherein said support plate fixing device allows said pair of support plates to move relative to said linearly movable ring in directions lying in a plane generally orthogonal to said optical axis when said support plate fixing device is in a released state;

a first rotatable shaft having a first axis generally parallel to said optical axis, supported by said linearly movable ring to be rotatable about said first axis, and having a pair of first eccentric pins at opposite ends of said first rotatable shaft, each of said pair of first eccentric pins having an axis eccentric to said first axis, said pair of first eccentric pins respectively engaged in said pair of first elongated holes to be movable therein in said direction of elongation of said first elongated hole, wherein when said first rotatable shaft is rotated, a first movement force is applied on said pair of support plates in a direction generally orthogonal to said direction of elongation of said first elongated hole;

a second rotatable shaft having a second axis generally parallel to said optical axis, supported by said linearly movable ring to be rotatable about said second axis, and having a pair of second eccentric pins at opposite ends of said second rotatable shaft, each of said pair of second eccentric pins having an axis eccentric to said second axis, said pair of second eccentric pins respectively engaged in said pair of second elongated holes to be movable therein in said direction of elongation of said second elongated hole, wherein

when said second rotatable shaft is rotated, a second movement force is applied on said pair of support plates in a direction generally orthogonal to said direction of elongation of said second elongated hole; and

a movement direction setting device, provided on said pair of support plates and said linearly movable ring, configured to set the direction of movement of said pair of support plates in a plane generally orthogonal to said optical axis when at least one of said first and second movement force is respectively applied on said pair of support plates by at least one of said rotation of said first rotatable shaft and said rotation of said second rotatable shaft when said support plate fixing device is in said released state.

19. (New) The camera according to claim 16, wherein said plurality of optical elements comprise at least one rear optical element positioned behind said retractable optical element when said retractable lens is in said operational state; and

wherein said retractable optical element is positioned in an off-axis space radially outside an on-axis space in which said rear optical element is positioned, such that said retractable optical element and said rear optical element are in substantially a same positional range in the optical axis direction, when said retractable lens is in said fully-retracted state.

20. (New) The camera according to claim 16, wherein said swingable holder further comprises:

a cylindrical lens holder portion holding said retractable optical element;

a pivoted cylindrical portion rotatably fitted about said pivot;

a swing arm portion located between said cylindrical lens holder and said pivoted cylindrical portion, said swing arm portion connecting said cylindrical lens holder to said

pivoted cylindrical portion; and

an engaging protrusion extending from said cylindrical lens holder portion, said engaging protrusion engaged by said eccentric pin of said adjusting shaft, when said swingable holder is in an operational position.

21. (New) The camera according to claim 16, wherein said retractable optical element comprises a lens group.

22. (New) The camera according to claim 16, wherein said optical system comprises a zoom photographing optical system; and

wherein said retractable optical element comprises a lens group as a part of said zoom photographing optical system.

23. (New) The camera according to claim 16, wherein said adjusting shaft comprises an operating portion via which said rotatable pin of said adjusting shaft can be rotated, and

wherein said operating portion is exposed to one of a front side and a rear side of said linearly movable ring and is accessible from one of said front side and said rear side of said linearly movable ring, respectively.

24. (New) The camera according to claim 22, wherein said operating portion of said adjusting shaft faces a frontward direction in the optical axis direction, wherein said retracting mechanism further comprises:

an outer barrel which surrounds said linearly movable ring, and has a radially inward flange located in front of said linearly movable ring,

wherein said radially inward flange includes a front through hole which penetrates through said radially inward flange in said optical axis direction, said operating portion of

said adjusting shaft accessible from the front side of said linearly movable ring through said front through hole of said radially inward flange.